SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, AUGUST 7, 1903.

CONTENTS:

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*EDUCATION AND THE WORLD'S WORK OF TO-DAY.**

IT is a time-honored custom in connection with the commencement exercises of our American colleges to read an address, for the benefit especially of those who are about to pass from the limited duties and responsibilities of studentship to the wider duties and responsibilities of citizenship. An opportunity is thus afforded for some last words of friendly counsel, and for a review of those ancient academic ideals which, while they have animated generation after generation of our predecessors, have survived them all, and are still a source of inspiration to our contemporaries. But appropriate as this sort of baccalaureate address may have been in the past, it now appears to be somewhat too scholastic for the happy day which marks the end of a college course of study and the joyful entrance of the graduates into the activities of professional and business life. Moreover, a just appreciation of good advice and a generous susceptibility to lofty ideals require a degree of physical comfort and a degree of mental repose rarely attainable in the heat of our average summer day. The solemn lessons of antiquity are losing their force, also, by reason of iteration and reiteration from the commencement plat-

* Commencement address read at Rose Polytechnic Institute, June 11, 1903.

form; so that one may no longer expect to strike a responsive chord, even in classical colleges, by an appeal to the ideas and the ideals of our distinguished ancestors.

It has seemed to me best, therefore, to depart from the beaten track, and to invite your attention to a subject which lies closer at hand; and as the merchant acts wisely in taking stock at the end of his fiscal year, so I trust we, teachers and students alike, may utilize advantageously the end of this academic year to enquire what education is and to what extent it meets the demands of our times.

We all know, of course, in a general way, what education means; but most of us would hesitate, I think, if called upon to give a concise definition of the word. Indeed, those of us engaged in the profession of teaching might be held to be ill-qualified to explain the import of the word. We are so near to the business and so much occupied with its details that we may fail to see it in its true proportions, and hence fail to estimate aright its effects and tendencies. On the other hand, those unacquainted with the elaborate machinery of educational affairs are plainly disqualified, for they lack the precise and intimate knowledge essential to define so comprehensive a term. If we appeal, American fashion, to the majority, it will be found that the consensus of public opinion regards education as a series of routine performances, carried on by means of more or less elaborate methods, involving tasks which students sometimes undertake with joy and sometimes with sorrow, and ending for those who complete the program with a ceremony called graduation. At any rate, this is what we usually mean by elementary education, and we all believe that its administration is desirable, if not essential, to the average boy or girl. And yet I think it would be found troublesome to explain just what is accomplished by this process and why a person subjected to it may be called educated and why one not so fortunate may be called uneducated. Of course, the easy explanation is at hand. We justify the process by its results. These are found to be on the whole elevating to the majority, and so we drift on with the current of public opinion, forgetting, commonly, that while this democratic leveling of intelligence has certain obvious advantages, it has also certain, though perhaps less obvious, disadvantages. And if we enquire what factors should enter into a scheme of elementary education, we at once meet with a confusing diversity of opinion and with the bewildering fact that the schemes already elaborated are so crowded with subjects that there is little chance of adding anything new, and so tenaciously maintained that there is little chance of omitting anything old.

But if we encounter difficulty in defining precisely the meaning and scope of elementary education there would appear to be still greater difficulty in formulating clear ideas as to the meaning and scope of higher education; for with respect to the latter we have to deal with a diversity of opinions which are to a large extent crystallized. Ask the average college-bred man what is the best line of work to pursue in a college course, and he is pretty sure to answer, if he replies spontaneously, that the line he himself pursued is probably the best, or, perhaps, unquestionably the best. Since the average collegian belongs to the traditional school, the average opinion is as unanimous as it is unilateral; and he who expresses it may justly fortify his view by pointing to the excellent results which have come from the pursuit of the time-honored literary curriculum, or, as he would prefer to put it, from the pursuit of the 'classics and the humanities.' Quite

recently, however, in the historical sense, there has arisen a new form of learning, under the name of science, which has now come to be generally recognized as worthy, at least, of a good share of our attention, if it is not comparable in value with the ancient learning; while some of the bolder advocates of science would give it first place in any scheme of education. This new learning, in the comprehensive sense now implied by the word science, is only about thirty years old. But to understand fully its meaning and to appreciate how profoundly it has affected educational matters, one needs to have lived in the prescientific as well as in the present epoch. Suffice it to say here that the advent of science in education was not accomplished without a struggle, which rose at times to a fierceness not altogether creditable to the combatants involved. But though the storm and stress of that struggle, happily, have died away, there remain some controverted questions whose adjustment must be left, perhaps, to you of the present generation to bring about; for we of the prescientific epoch can not discuss them without arousing prejudice which is attributed either to irrational conservatism, on the one hand, or to sweeping iconoclasm, on the other.

I may allude, in passing, to certain forms of this prejudice, and suggest that our sense of humor should help much to dissipate the intellectual fogs which obscure these matters of controversy, and hence lead to solutions which will rest on foundations of merit alone. Thus, even at the present day, many of the older school of education hold, tacitly, if not openly, that studies may be divided into sharply defined categories designated as 'liberal,' 'humanistic,' 'scientific,' 'professional,' 'technical,' etc.; and men and women are said to have had 'a liberal training,' 'a professional training' or 'a technical training,' as the case may be. They say, by implication at least, that mathematics, when pursued a little way, just far enough to make a student entertain the egotistic but erroneous notion that he knows something of the subject, is an element of liberal training. On the other hand, if the student goes further, and acquires a working knowledge of mathematics, his training is called professional or technical. Similarly, studies which include the memorabilia of Xenophon and Cæsar, the poetry of Homer and Virgil and Dante and Shakespeare, or, in short, the so-called polite literature of ancient and modern times, are said to lead to breadth and culture; while studies which include the works of Archimedes, Hipparchus, Galileo, Huygens, Newton, Laplace and Darwin are said to lead to narrowness and specialism; as if the first class of authors were somehow possessed of humanistic traits, and the other class of demoniacal tendencies. So far, indeed, are these distinctions carried that higher moral qualities are not uncommonly attributed to the young man who studies Latin and Greek in order that he may earn a living by teaching them than are attributed to the young man who studies engineering in order that he may earn a living by building bridges which will not fall down and kill folks.

But, you may ask, is it not possible, in spite of tradition, prejudice and conflict of opinion, to lay down some practical precept or working hypothesis that will enable us to proceed along different routes toward the common goal with reasonable hopes of success? Experience during the past thirty years has given, I think, an affirmative answer to this question. We need only to enlarge our definition of education in order to include all that is good in the new learning and to retain all that is good in the old learning. The only im-

perative restrictions are that we must not prescribe the same curriculum for all students, and that we must not entertain invidious distinctions with respect to any of the curricula. According to this view, then, the formal education of schools and colleges does not consist, as many well-educated people seem to think, in the pursuit of certain studies, but rather in the pursuit of some studies thoroughly well. Herein, it seems to me, is the theoretical as well as the practical solution of the whole matter of the conflict of studies. Provisionally, we have pretty generally reached this conclusion in America. It only remains to replace the narrowness which is willing to accept the traditional limits of learning by a breadth which would hesitate to set any such limits.

If we accept this enlargement of our intellectual horizon, and there seems to be no doubt that we shall soon do so, it will be easy to brush away the distinctions which have long clouded our minds, and still affect our judgments, in the classification of studies. The adjectives liberal, technical, humanistic and professional, as commonly used to denote differences or to mark invidious distinctions, will be found to be, usually, misleading or meaningless. All studies conscientiously and laboriously pursued will be seen to be liberalizing and humanizing, whether they be pursued with or without a technical or professional end in view. That it is any more creditable to study the works of Dante and Shakespeare than it is to study the works of Galileo and Darwin will be found to be a frail figment of the imagination, growing out of the supposed holiness of metaphysics and the supposed unholiness of physics.

In the educational transformation that has come about in the last three decades, our schools of science and technology have played an important rôle. It goes without saying that they have demonstrated their right to existence, that they have come to stay, and that they should play a still more important educational rôle in the future. They have won their way to prominence in spite of all opposition; and I think it may be justly said that in thoroughness of work and in the development of the spirit of energy and independence essential to the successful and useful citizen they have already surpassed the older classical colleges. But the strength of their position is measured not so much by academic standards as by the achievements of their graduates. The world no longer asks where and how men have been trained; it goes straight to the point and enquires what they can do. This is the supreme test. That the graduates of our technical schools have met this test successfully is proved by their efficiency in nearly every walk of life. The prominence of their work is especially noteworthy in the great industrial progress of our times. The civil, the chemical, the electrical, the mining, the metallurgical, the naval and the sanitary engineer have established a claim to recognition among the learned professions. Astronomers, botanists, chemists, geologists, geodesists, physicians, zoologists and other so-called specialists have also demonstrated by actual achievements that a scientific training fits men well for the work of the world.

In the meantime great changes have likewise taken place in the curricula and in the attitude towards science of our classical colleges. Most of them have given place in their required or elective studies for the principal sciences. Many of them have limited the requirements in the classical languages to a minimum; while a few of our leading institutions have gone so far as to give the degree of A.B. without any requirement in Latin or Greek.

It is a significant fact, also, that the scientific method and the scientific spirit of investigation have worked striking changes in attitude toward their own specialties among the devotees to ancient learning. Thus they speak of the science of history and the science of theology, and even of laboratory methods in these sciences; and among themselves, teachers of the classics are not infrequently referred to as scientific or archaic, according as they are animated by modern or mediæval ideas. A few eminent educators deplore these tendencies and write regretfully of the vanishing monastic features of college life. A few rail bitterly against what they call 'the materialism of science,' and charge that the perfume of the Attic violet is being stifled by the mephitic odors of the laboratory. Others assert that, while science may be good enough for engineers who build railroads and dig canals, the classics and the humanities are alone fit for the scholar and the gentleman. But the trend of progress is clearly visible in these as well as in other signs of our times. Mediæval methods, customs and ideals are slowly yielding to the reason of modern thought.

Once free from the bias and the restrictions of inherited opinions, education must appeal to us with a broader and a deeper significance. In the best sense of the word, education is a process which should begin in infancy and end only in advanced age. Science has demonstrated that man is a part of, and not apart from, the universe in which we live; and education in the comprehensive meaning of the word is the process of development which fits us to play well our parts in the infinite variety of phenomena which mold us and which we in turn help to mold. Hence the question of education is a many-sided and a far-reaching one, to the larger aspects of which we even who are engaged with some of its formal details can only point the way. Schools and colleges serve only to give the student a start, whence he enters the 'University of the Universe,' from which there are no graduates. Each may choose his own field, and if he would be a master in it he must become a specialist. Of course there are those who decry the present as an age of specialists and speak and write ruefully of former times when the more learned minds were able to compass the entire domain of accepted learning. But those were times when accepted learning was mostly of the kind called 'polite,' times when the rapidly rising sciences and their devotees were referred to with anything but terms of politeness. The change from this not very remote past is irrevocable, however, and it is plainly our duty to make the best of the new conditions, full as they are of novelties and perplexities. The recent great increase in the quantity of indispensable knowledge forces us to a hitherto unheard of division of labor in the educational field. The specialist is, therefore, a necessity, though there never was a time when the qualifications of a specialist were so numerous and so exacting. In fact, it may be truly said that one's training now must be broadly liberal in order that it may be minutely special.

The age in which we live is preeminently the age of educational opportunities. The school, the college, the university, the library and the museum were never so numerous, so free and so efficient as at the present time. Hundreds of experts, in the study and in the laboratory, in the office and in the field, are contributing by their researches to the world's stock of knowledge. Hundreds of literary, historical, scientific and other technical societies are annually swelling the published volume of the world's best learning; while, in a pop-

ular way, the newspaper, the journal and the magazine bring daily, weekly and monthly instalments of this best learning to him who can read it aright. Intercommunication by post and by telegraph, and quick transportation over land and sea are rapidly dissipating class prejudices and supplanting them by friendly rivalries in the common educational advance. The illusions which some eastern institutions have long held with respect to their superiority over institutions in other localities, are rapidly vanishing before the tests of merit and achievement. Indeed, if one may judge from the picked men who pursue work for the higher degrees in our graduate schools, it would appear that the center of education, like the center of population, is no longer east of the Appalachian Mountains.

So far then as opportunities go, the college student of to-day has great advantages over his predecessor of thirty or forty years ago. Verily, no one need thirst in vain for knowledge, for the fountains thereof are to be found flowing on every hand. But, to paraphrase an old saying, while we may point out the fountains of learning we may not be certain that men will drink deeply or effectively therefrom. It seems proper, therefore, to enquire to what extent these available advantages are appreciated and utilized by the average student of to-day.

It would be quite unreasonable, of course, to suppose that the student of the present day is very different from or much abler than the student of a generation or two ago. The capacity of the human mind, like astronomical phenomena, is subject mainly to secular variations. There is no doubt, however, that the great increase in knowledge and the enlarged means for its diffusion, in recent times, have led to a perceptible quickening as well as to a perceptible broadening of the intellectual faculties of men. What may be called the experience of life, and this is, in general, the most important part of education, is begun earlier and is realized in larger measure than ever before. Coming thus to the college or university better acquainted with men and things and pursuing a broader and a more laborious course of study, the graduate of to-day is, as a rule, a better equipped and a more efficient man for the work of the world than any of his forerunners. More is expected of him, more is required of him and more is accomplished by him than in any preceding age.

But while this is the character we may justly attribute to the majority of our college men, there is a noisy minority of them who have succeeded, apparently, in convincing the public, and to a large extent college authorities, that one of the principal functions of an educational institution is the cultivation of muscle and the conduct of athletic sports. Along with the growth of this minority there has sprung up, also, a class of less strenuous men, who, taking advantage of the elective system, are pursuing courses of aimless discontinuity involving a minimum of work and a maximum of play. They toil not, except to avoid hard labor; neither do they spin, except yarns of small talk over their pipes and their bowls. I need not explain to you that these types of men are well known in natural history. From time immemorial the gladiator and the Miss Nancy have received much of that fleeting attention which the careless crowd bestows on the gaudily attired tumblers of the circus and on the transparent masks of pretenders. It is not so well known, however, that these types of men—prospective bachelors of athletics and degree-hunting dudes—are now wielding an influence distinctly

inimical to academic ideals and distinctly debasing to academic morals.

Pray do not misunderstand me. I am not opposed to physical culture and athletic sports. Scarcely any element of education is so important as the attainment of a healthy balance between the intellectual and the physical functions of men. The ancient maxim of a sound mind in a sound body is more fitting now than ever before. We know or ought to know much better than our ancestors to what extent clear thought and right action depend on good lungs, sound hearts and unclogged livers. My protest is not against school and college athletics as such, but against athletics as they are now generally carried on, and especially against intercollegiate contests. As now practiced, athletics seem to me to defeat the object they are intended to attain. They cultivate almost exclusively the men who are usually more in need of intellectual training, and they ignore almost completely the men who are physically defective. The latter are only permitted to stand by and whoop for their alma mater and for her gladiators. Strangely enough, too, the advisers and trainers of our teams and crews are not always men to whom good judgment would commit the training of youth, but they are often men as ignorant of physical culture as they are of mental and moral culture; their names, indeed, are commonly better known to the patrons of the turf and the ring than they are to the patrons of the cap and the gown.

The usually keen American sense of humor seems to have failed us in these matters. Thus the reporters appear to think it essential to state that every distinguished college graduate who dies was a noted athlete in his day, and they often ascribe great prowess to men of a notably opposite physique. One might infer also, from the prominence given to the small number of 'punters' and 'half-backs' of the day, that they are the only college men who are likely to succeed in life. The sporting populace and the sporting alumni go wild with enthusiasm over intercollegiate contests, while the press, in a fashion similar to that followed in describing prize fights, devotes much more space to these ephemeral events than it does to all other educational affairs combined. It is no wonder then that the light-headed undergraduate attires himself like a stable-boy and affects the manners and vices of a cowboy without aspiring to the virtues of either. He may be excused also for entertaining the hypothesis that colleges are athletic clubs, and that his professors, as suggested by Mr. Dooley, will proceed leisurely to take for him the requisite minimum of formalities leading to a degree.

There is a darker side of this question which calls for something more than a quickened sense of humor. It is the vast expense entailed by these extra-academic operations. Fifty to a hundred thousand dollars per annum are certainly not needed by a college or a university to provide adequate physical training for a few athletes and amusement for a few hundreds of men who can not find health and pleasure in more useful occupations. In so far as educational institutions tacitly encourage the practice of this sort of political economy by students, the majority of whom have yet to try their hands at self-support, they must be held guilty of promoting a degree of extravagance which in other walks of life is usually associated with open corruption.

But the fashions, the follies and the fads of college men, like those of any other limited community, play an insignificant rôle in the larger drama of life. However im-

portant to his little circle a student may have been as an undergraduate, he is likely to meet with a chilly reception unless he is well qualified for arduous service in the work of the world. Those who have thus qualified, however, may go forth with confidence; for as ours is preeminently the age of educational opportunity, so is it preeminently the age of professional and business opportunity. There never was a time when talent, energy and enterprise in young men were so much in demand as at present. Men who can plan and execute; men who can work out knotty problems in engineering, in transportation, in sanitation and in finance; and men who can study aright the mighty questions of industrial and social economy now confronting us, are everywhere needed. Above all, there is a demand for men who can see straight, and who can live lives free from moral obliquity; men who can expose the frauds of politicians and the tricks of boodlers and grafters; and men who can demonstrate, by example as well as by precept, that the homely virtues of honesty, industry and sobriety are not dying out in our land.

The world demands men who are not afraid of hard labor; those who would work during a portion, only, of their leisure time, need not apply. The world demands men who are patient and enduring; those who can not find pleasure in business, but who would make a business of pleasure, are not wanted. The world demands men of courage and convictions; those who vacillate and temporize are sure to be beaten in the race of life.

Young men often wonder why they get on so slowly and why the world puts so low an estimate on their abilities. While the element of chance is not wholly negligible in these matters, and while 'influence' and 'pull,' especially in politics, sometimes interfere with 'natural selection,' the reason is generally plain in any individual case. The simple fact is that the world sets severely high requirements for the competent and the trustworthy, and in nine cases out of ten the men who are rejected have failed to pass in these requirements.

Along with the great advantages now afforded for education, and along with the inspiring fields of work now open to educated men there should go a correspondingly high sense of duty on the part of our college graduates. They are in no sense aristocrats, and they would become ridiculous in the assumption of any unproved superiority. Nevertheless, if they are too sensitively possessed of that modesty which is born of a knowledge of things, we may say for them *noblesse oblige* without undue hesitancy. You who go forth to-day, therefore, must assume, if you bear well your responsibilities, new and increasing obligations, obligations to your college, obligations to your country and obligations to your fellow men of the world.

Those of you who have caught the spirit of progress which animates modern science have a special duty to perform. Ours is the epoch of unparalleled improvements and advances. In all that makes for the permanent progress of humanity, the contributions of science in the nineteenth century alone are held by competent judges to compare favorably with those from all other sources throughout historic time. You are among the heirs of these contributions, and it rests with you, in part, to determine what use may be made of them. A flood of light is available, but it would appear to illuminate the intelligence of only a small fraction of our race. When we consider to what extent superstition and error prevail at the present day with the most enlightened peoples of the world, it is plain that the scientific habit of mind is

none too common. We smile, for example, at the folly of the sailor whose fears may be drowned in a pot of beer and who commits his fate to a rusty horseshoe nailed over the entrance to his forecastle. And yet, our 'city fathers' permit epidemics of typhoid fever to prevail with startling frequency and with frightful mortality. Think, too, for a moment of the shocking waste of health and wealth to which the alluring advertisements of quacks and other charlatans bear testimony in the daily and weekly press. Think also of the waste of time and money which comes from the habit of gambling so common in all races from the lowest to the highest. All such vices are deeply rooted in the human family and fortified by our superstitious tendencies to accept without proof anything which promises the marvelous. No mere literary training can help much to overcome this deplorable inheritance. Nothing short of the scientific frame of mind and habits of thought can prevail against such ancestral traits.

There is endless scope, therefore, for additional improvements and advances along the lines your training in science has fitted you to follow. Science bids you look forward, then, with confident optimism. But you should waste no time in idle contemplation of the splendid achievements already attained. The price of progress, like that of liberty, is eternal vigilance. One must be ever active, ever patiently persistent, proving all things and holding fast to that which is good.

R. S. WOODWARD.

---

*THE RELATION OF SCIENCE TO COMMON LIFE.**

I HAVE been honored by being selected to speak to you on the present occasion. The high ideals of this society demand that I should attempt to leave my restricted field of study for a time, and that I should speak of those broader questions that agitate general scientific thought—that I should drop the rôle of the botanist, and assume that of the scientist and the man.

My theme is 'The Relation of Science to Common Life,' the life of the mass of individuals, of the nation, if you will. A very unacademic subject, you will say, as measured by the older standards. I chose it on that account. In not a few university centers, the time has not long gone when such a subject would have been curtly dismissed with the remark, 'We have nothing to do with common life; we follow our own high educational aims.' Too often the universities have stood aside in cold and unsympathetic isolation—shall I not also say in helpless disfavor—while the busy thinking world outside has carried forward the beacon lights of truth and progress. Listen to Whewell when, as Master of Trinity College (Cambridge), he went up to London fifty years ago to deliver his notable address before the Royal Institution. Speaking on 'The Influence of the History of Science upon Intellectual Education,' he said: "I venture to address you, relying upon an indulgence which I have more than once experienced. Of such indulgence I strongly feel the need, on various accounts, but especially that, being so unfrequently in this metropolis, I do not know what trains of thought are passing in the minds of the greater part of my audience who live in the midst of a stimulation produced by the lively interchange of opinion and discussion on the prominent questions of the day." Uttered soon after the exhibition of 1851, and when the scientific world was entering on new conquests, such an apology may seem unaccountable. Happily, our university presidents of to-

* Sigma Xi Society address, June 18, 1903, before the chapter of the University of Pennsylvania.

day are more in touch with the throbbing, vibrating life of humanity, even though they may not claim the profundity of thought that lived in the master of 'Trinity.'

If there be one characteristic more than another of our age and day, it is the steady welding and cooperative development proceeding among the leading races of the world. Nowhere is this seen on so phenomenal a scale as in our country, where, with the Anglo-Celt, Jew and Greek, Frank and German, Italian and Norseman together ply the arts of peace. And why such a commingling of human lives? The answer may be given, and so far well, that here liberty is assured to all, that equal rights and equal opportunities come to all. Back of this, however, is the basic fact that in this country scientific progress has been comparatively unhampered by costly patent laws, by hereditary vested rights, by lands being held in the hands of a few. But perhaps above all, and permeating all, though often silently working, there exists a keen and rapid method of inductive reasoning that carries forward the individual and the community on progressive and yet safe lines. It is this method, applied to all branches of science with increasing exactness, as human freedom increasingly asserted itself during the bygone century, which has culminated in the marvelous scientific position occupied by the country to-day.

Our Sigma Xi Society, as a university organization, stands for 'the nobility of science.' What then is its relation to the university on the one hand, and to the common life of mankind on the other? In reply, let me quickly review the growth of universities during the past millennium. With Lacroix we may regard the University of Paris as the first great effort made by Abelard and his successors to dispel the shades of the dark ages. Here in the four nations met scholars of every language, creed and degree of poverty or wealth. A thirst for learning was their common bond. Later the Universities of Bologna, Padua and Oxford widened and deepened the channel of democratic learning, that spread out and vivified Europe. It is noteworthy that amid all the machinations of emperors, kings, popes and knights the fearless champions of freedom of thought, and so of freedom of the individual, from the tenth to the fourteenth century, issued from the universities, and were often more powerful, and more feared by autocratic rulers, than armed hosts.

But the appearance in succession of Galileo, Francis Bacon, Descartes and Newton, with many lesser lights clustered round, gave rise to that comparatively recent university renaissance which is spreading to widest proportions in our own land and time. We owe it *almost wholly* to the close pursuit of accurate inductive, scientific methods, which have yielded deductions of profoundest value. By slow degrees, through observation and experiment, fact has been cumulated on fact, till these have, in their combined perfection, permitted some great hypothesis to be advanced, or some great law to be deduced, that has grouped all lesser laws in crystal-like symmetry.

But only after the biological inductions and deductions of Lamarck, Spencer, Wallace and Darwin were we in position to apply scientific methods to living things, to man himself. One fundamental keynote of their teachings is that 'Use vindicates and prolongs existence.' The cry is still raised, though from a scattered remnant that is fast being left in the rear of educational progress, that utilitarianism is disastrous to university education and to highest scholarship. This remnant desires

to retain the exclusive spirit and sectarian bigotry that characterized some universities, which had started well but unfortunately were 'captured' for a time by a privileged and unrepresentative few, from the sixteenth to the nineteenth century. John Bright dubbed one of these institutions with cutting but deserved sarcasm as 'the home of dead languages and of undying prejudices.'

Science knows no such distinctions, and refuses to recognize them. She writes deeply on the warp and woof of human and of all organic existence the law that *utility conserves, strengthens and continues life, that disuse weeds out and destroys.* I glory then in the utilitarian, which in the recently gone century has stirred our common human life to titanic action in every field, has revivified and advanced true education, has sown broadcast colleges and universities, and has sent forth from these enthusiastic disciples aglow with the spirit of research and of experiment. This young century, then, before its death, will witness mighty scientific achievement, compared with which all that has been unfolded will be only the prelude.

But here let us linger over the terms use, utility, utilitarianism. It is easy to distort and misconstrue their precise scientific significance. When one looks with the botanical eye at those large, bright-blue marginal florets of the corn-flower, and discovers in them neither stamens nor carpels for fruit production, one is apt to exclaim hastily: 'They are useless, they have no claim to existence.' But patience tells us to watch, to observe and to learn how these attract passing insect visitors to the small inconspicuous central florets, which by aid of the attracted visitors set abundant fruits. The marginal florets seem at first gaudy superfluities, but though they have only one use in life, like the leader of men who had once blacked shoes, they can all claim: 'Didn't I do it well?' Every scientific fact is *useful*, but may not necessarily be *used*. As Darwin patiently dissected cirripeds, studied and described the structure of orchid blooms, observed the slow revolutions of twining plants, counted the number of seeds that different plants might produce, a financial speculator escaped from the unhallowed bedlam of the stock exchange, and looking in on the sage in his quiet country home at the week's end to cool his nerves, might have declared it all a waste of time and labor. We know that Darwin was laying the foundations of those principles that have revolutionized all thought, and that he was paving the way for the economic death of this speculating friend, who biologically is a human parasite.

What relation then has science, and should it have, to our universities on the one hand, and to common life—to the mass of free, earnest thinking people, on the other? In attempting to answer we must constantly keep in view tradition and history—our relation to our ancestors, real or imaginary. We all, like the Chinese, worship these ancestors—at least in their relations—and they worship them most powerfully who are furthest removed from the land that gave them birth. So it is that we fear to break with the past, and inherit incongruous combinations. Says Whewell in the lecture already referred to: "You will not be surprised to be told that our modern education has derived something from the ancient Greek education, because you know that our modern science has derived much from the ancient Greek science. You know that our science—in the ordinary sense of the term—has derived little from the ancient Romans. * * * But if we take the term science in a somewhat 'wide' acceptation, we shall derive from the Roman history

not a negative but a positive exemplification of our proposition. For in that wider sense there *is* a science of which Rome was the mother, as Greece was of geometry and mathematics. The term science may be extended so widely as to allow us to speak of the science of law—meaning the doctrine of rights and obligations, in its most definite and yet most comprehensive form; in short the science of jurisprudence. * * * And thus two of the great elements of a thorough intellectual culture—mathematics and jurisprudence—are an inheritance which we derive from ages long gone by; from the two great nations of antiquity."

So far Whewell, who in attempting to elevate Roman law to the dignity of a science forgot that much of it was unscientific to the last degree, and tended to produce, not organic national equilibrium, but to set the patricians against the plebeians, and both against the bondmen, who often showed finer qualities than either. Little wonder is it that Rome fell, unsaved by her laws.

Let us see whether a different viewpoint and source of origin for the science of law and equally for all scientific relations might not be obtained. Huxley thus puts it: "It is a very plain and elementary truth that the life, the fortune and the happiness of every one of us and, more or less, of those who are connected with us, do depend upon our knowing something of the rules of a game infinitely more difficult and complicated than chess. It is a game which has been played for untold ages, every man and woman of us being one of the two players in a game of his or her own. The chess board is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of nature. * * * Education is learning the rules of this mighty game. In other words education is the instruction of the intellect in the laws of nature, under which name I include not merely things and their forces, but men and their ways; and the fashioning of the affections and of the will into an earnest and loving desire to move in harmony with those laws. * * * The object of what *we* commonly call *education*—that education in which man intervenes and which I shall distinguish as artificial education—is to make good defects in nature's methods, to prepare the child to receive nature's education. * * * In short all artificial education ought to be an anticipation of natural education. And a liberal education is an artificial education which has not only prepared a man to escape the great evils of disobedience to natural laws, but has trained him to appreciate and to seize upon the rewards which nature scatters with as free a hand as her penalties." To pursue Huxley's reasoning to its ultimate limit, advanced teaching of all the laws of nature is the highest function of the university in relation to our common life. In other words to make each man who leaves its portals most highly qualified for useful, intellectual, manly life. But, as I hope to show later, this qualification is to enable him to use wisely—not meanly—the forces around him, so as to build society into an organism.

Therefore, every upright pursuit in life which man enters on should have the highest principles and practice governing it represented and taught in our universities, by the best men in the most perfectly equipped manner. This may be an ideal at present. Granted, it is nevertheless one toward which, I am persuaded, every university must move. In this manner science will confer the dignity that is deserved on the physician's scalpel, the bricklayer's trowel, the chemist's test-tube, the engineer's lathe, the biologist's microscope, the

agriculturist's spade or ploughshare. When he saw the spirit of destruction honored and that of construction lightly esteemed, Carlyle rightly growled out as follows in his immortal 'Sartor Resartus': "The Hinterschlag professors knew syntax enough, and of the human soul this much: that it has a faculty called memory, and could be acted on through the muscular integuments by appliance of birch rods. Alas! so it is everywhere, so will it ever be, till an *architect* is hired, and on all hands fitly encouraged; till communities and individuals discover, not without surprise, that fashioning the souls of a generation by knowledge can rank on a level with blowing their bodies to pieces by gunpowder; that with generals and field-marshals for killing, there should be world-honored dignitaries, and, were it possible, true God-ordained priests, for teaching. But as yet, though the soldier wears openly and even parades his butchering tool, nowhere, far as I have travelled, did the schoolmaster make show of his instructing tool; nay, were he to walk abroad with birch girt on thigh, as if he therefrom expected honor, would there not, among the idler class, perhaps a certain levity be excited?" Happily the twentieth century gives promise of emancipation alike from the marshal's sword and the dominie's rod. It is for us to struggle toward securing that honored recognition for every branch of knowledge which Carlyle dimly presaged.

It has often been urged that the intrusion of so-called technical science into our universities will break up all cherished university ideals and dissipate the poetic side of life. Both objections are equally erroneous. Even in acquiring the most technical detail of science, the student can still exclaim with Kepler, in all humility and dignity: 'O God, I think thy thoughts after Thee.'

And as to real poetry and romance, science is just beginning to unfold such. You will forgive me, as a botanist, while I tell you of the wonder and pleasure our students expressed about a month ago, when carried past Jersey fields of scarlet clover in full bloom. This plant had converted former sandy wastes into a floral paradise. But more, our workers had learned the reason for its presence in such quantity, and could picture to themselves the originally scant, but now rapidly multiplying, myriads of 'nitromonas' bacteria that were absorbing and fixing loose atmospheric nitrogenous compounds. They knew that these handed on much of this to the *Rhizobium* organism of the soil or of the clover tubercles, and that finally the fixed assimilated nitrates were utilized by the clover for its sustenance. Truly a romance verified.

Let me try to pick up another with you from the gutter, and illuminate it with the rays of latter-day discovery. Philadelphia every year pours into her rivers millions of tons of sewage. As you are aware, this is rich in all the chemical products needed for plant life, but, like every valuable thing, it must be handled carefully. We have hitherto called it waste, and have puzzled our brains how to get rid of it. One of our railroad companies has found it profitable to build a large viaduct over the Delaware to carry our citizens quickly to the New Jersey coast. No one has yet been enterprising enough to build an equally large aqueduct into which our sewage might be pumped, and ultimately distributed over the thirsty but capable sands of New Jersey, which would blossom into life were such given. To apply the statistics now to hand, 4,000 acres of New Jersey land within ten miles of Philadelphia could then be made to produce the fruits and roots that Phila-

delphians consume, while much of the sewage water might again be collected, and returned to us as hygienic water which might well replace that of the unregenerate Schuylkill. The correctness of every detail of this Berlin has already demonstrated in her broad irrigation system.

In the accomplishment of such truly romantic results the schoolman and the layman, the university teacher and the shop worker, have equally had to do. Already it is recognized that to prepare, cut, stain and microscopically examine a paraffin section, or to separate out the constituents of a chemical mixture, are both liberal educations in which the skilled hand, eye, nose and ear all cooperate with their complex and correlated central manifestation that we call *mind*. Measured by such methods knowledge is not the mental quantity and quality supplied by this or that university, but is the earnest effort of man to enlighten and guide himself and his fellow man.

As brethren of the Sigma Xi then it becomes us to agitate constantly for the restoration of the grand ideals set by Paris and Bologna universities of the tenth to the fourteenth century. There learning was imparted to all who loved it, there nationality, or name, or condition formed no bar to the owner—whose gown at times served to cover his rags, and there the scholars of their day—courted by emperor and entertained by the nobles—were the teachers of these famous old centers. Above all we should so school ourselves as to be ready to slough off during each unfolding year—with its new possibilities for progress—the skin of prejudice or preference that may have hardened round us in the preceding period. The biological teaching of Huxley in '55 was very different from that of '75, and this again from that of '90. In university life the caution is constantly needed. A recent magazine number chronicled the people's vote of three large cities, in favor of municipal ownership of distributive agencies, and somewhat pungently added: 'While the academicians are discussing the theory of municipal ownership the people, in these cities at least, are getting into the habit of voting for it.' Periodic intellectual molting conduces often to sound mental life.

It is a property of most scientific questions that they project themselves into the future. Whether we accept the teachings of Kidd's suggestive couple of volumes or no, his prophetic outlook into the future is inspiring, and despite destructive criticisms his principle of 'projected efficiency' is one that every true scientist tacitly believes in and works up to. We all think of leaving the world better for our descendants—be they fleshly or mental children—and the man who asked in selfish unconcern, 'What has posterity done for me?' deserved no children, and equally deserved that his good deeds should be buried with him. Like that of Paul, our life should be a consecrated unrest. We have not yet attained, neither are we already perfect.

While it will gladly be conceded that few if any countries foster scientific advance more than America, it will as readily be conceded that this has been mainly on the applied side, and that much remains for accomplishment in non-remunerative educational equipment. Here I place in front rank the need for spacious and splendidly furnished museums for all the sciences. Those of us who have walked, time and again, through the mechanical, the chemical, the zoological, the mineralogical and other sections of the South Kensington Museum, or corresponding ones of the continent—not to speak of many local museums of lesser

repute—know that we have nothing to compare with them. Suppose we make observation for a time in the mechanical section, where accurate models may be even seen at work. There the schoolboy lingers inquiringly before them, and he thus forms great conceptions of man's inventive relation to the world forces around him. The factory worker learns how his machines have grown, have been evolved, and how he may possibly perfect them further. For the college and university teacher these collections furnish comparative and concrete illustrations by which a lasting picture is fixed in the mind. Such institutions are costly to erect, to furnish, to man, and to support annually. Their high educational worth must be gauged not by the fruits of years, but of decades and centuries, for the mental stimulus they afford is often hidden away and silent. The question of cost should be a minor consideration in planning such undertakings, amid the corporate and individual wealth that characterizes such centers as our own. Civic pride and loyalty, national pride and loyalty, pride in and loyalty to our highest human development should be sufficient impelling force. Here let me say, with all caution and reserve, but yet with perfect conviction of purpose, that when we read or learn of lavish individual expenditures, for individual gratification alone, it should arouse in every one of us the desire to so mold public opinion that such superfluous ostentations shall cease. If the owner of the wealth thus diverted can be shown that his wealth can most patriotically be expended in building up the country's institutions, then we have successfully done battle for the right. If history has lessons for us, does it not remind us that at one phase of Rome's history the poet could truthfully say,

> "For Romans in Rome's quarrel, spared neither land nor gold,
> Nor son nor wife, nor limb nor life, in the brave days of old,"

and that a later time came when Rome's matrons had few if any robust sons to fight, when the patricians had largely squandered their patrimony in sensual indulgence, when—with decayed institutions—none were 'so poor as to do her reverence.'

Let me suggest another need or couple of needs, easy of fulfilment, and which it behooves us as members of the Sigma Xi to supply. I refer to a graduate and undergraduate society or branch of this one, for general scientific improvement and information. We as graduates and teachers are, or unfortunately in some respects must be, specialists living and working along narrow grooves. A vigorously and comprehensively planned meeting, held once a month, would refresh and expand us all. Picture to yourselves a meeting such as we might have had during the past few weeks with an intellectual bill of fare such as the following: 'The Separation and Properties of Radium,' 'The Biology of Laziness,' 'The Dotter in Naval Practice,' 'The Organism of Smallpox,' 'The Physical Principles involved in the Formation of Mountains' and 'Luminous Bacteria as a New Illuminant.' To finish these in a night would afford a meal worthy of mental digestion for a month. Such meetings would also promote that *esprit de corps*, that common effort, that contagious enthusiasm, that self-sacrificing spirit, which when combined ensure an institution's progress.

Equally would I urge the need for undergraduate organization, though largely for other reasons. Our developing scientists and aspirants to the honors of Sigma Xi should have fullest opportunity for debate, discussion and presentation of views. A

freshness and savor would be imparted to class work that those of us who are teachers desire; it would early promote the spirit of research, and would quicken each speaker to excellence in literary style and oratorical effort. Too little attention is often give to form, and too much to substance, in scientific presentations.

A few sentences back a note of warning was sounded against the dangers of specialization. I trust that every one directly or indirectly connected with our institutions realizes its dangers. Though Darwin pathetically confessed as to its effects, no one has put it more forcefully than Stuart Mill, who says: "The increasing specialization of all employments; the division of mankind into innumerable small fractions, each engrossed by an extremely minute fragment of the business of society, is not without inconveniences, as well moral as intellectual, which if they could not be remedied, would be a serious abatement from the benefits of advanced civilization. The interests of the whole—the bearings of things on the ends of the social union—are less and less present to the minds of men who have so contracted a sphere of activity. * * * This lowering effect of the extreme division of labor tells most of all on those who are set up as the lights and teachers of the rest. A man's mind is as fatally narrowed, and his feelings towards the great ends of humanity as miserably stunted, by giving all his thoughts to the classification of a few insects, or the resolution of a few equations, as to sharpening the points or putting on the heads of pins. The 'dispersive specialty' of the present race of scientific men, who, unlike their predecessors, have a positive aversion to enlarged views, and seldom either know or care for any of the interests of mankind beyond the narrow limits of their pursuits, is dwelt on by M. Comte as one of the great and growing evils of the time, and the one which most retards moral and intellectual regeneration. * * * He demands a moral and intellectual authority charged with the duty of guiding men's opinions and enlightening and warning their consciences; a spiritual power whose judgments on all matters of high moment should deserve and receive the same universal respect and deference which is paid to the united judgment of astronomers in matters astronomical." We must acknowledge, to a large degree, the saneness of Mill's position, but if we all cease specializing one day in the seven at least, the spiritual power desiderated will have opportunity to dwell in our midst. The Jewish Sabbath is by no means the worn-out institution that some would have us believe.

Another rock ahead in the channel of progress demands most careful consideration and steady action. Our present-day political and economic systems often foster methods by which science and scientific discovery are degraded or robbed of their true value, while the scientific worker is often defrauded of that reward that should come from sturdy effort of mind and hand. It has truly been said that 'crafty men contemn studies, simple men admire them, wise men use them.' The founding by Besant of what might be called 'the authors' mutual protection society' marked an epoch in the history of English literature. No such organization has yet been evolved to foster and protect scientific discovery. The attempt has been made in some scientific circles to divorce the discoverer from the fruits of his labors, under the specious plea that it is unprofessional to be associated with these in trade relations. Yet were he allowed or enabled to guide their progress, he would often place them before mankind on a more generous footing than when they are left to be ex-

ploited by some crafty unscientific dealer. But to put the whole question on a much higher plane than that of mere financial well-being, I venture to say that since science stands for accuracy, probity, clear statement of fact, unveiling of error of every kind—whether intentional or unintentional—it can have no sympathy with the deceit and chicanery that are so rampant around us, and that threaten at times even to swamp the high ideals of our universities. Toward the close of his valuable work on 'The Rise of the Swiss Republic,' McCracken says: "It has become somewhat of a commonplace assertion that politics in the United States have reached the lowest stage to which they may safely go. There seems to be no longer any necessity to prove this proposition, for the general conviction has gone abroad, amply justified by the whole course of history, that no democracy can hope to withstand the corrupting influences now at work in our midst, unless certain radical reforms are carried to a successful conclusion. Our calm American complacency seems, at length, to have received a shock; our habitual optimism to have given place to a feeling of apprehension, lest the malignant forces now uppermost in our national life may not, after all, prove too strong for us; and a corresponding desire is being manifested to set in motion other benign forces which shall save the state from destruction while there is yet time.

Unfortunately all attempts to probe the fundamental first causes of our corruption are checked at the outset by the difficulty of bringing the popular will to bear upon public questions. Our whole administrative system, and all the methods by which the people are supposed to make known their desires, are perverted and diseased, so that the sovereign body are prevented by mere tricksters from exerting their legitimate control over the making of the laws which are to govern them. We are suffering not only from deep-seated economic and social diseases, of which perhaps the most alarming symptom is the concentration of wealth into the hands of a few, but from the rule of the boss, and from the lamentable fact that the people at large are divorced from legislation. As a matter of fact nothing stands between us and the tyranny of municipal, state and federal bosses, as unscrupulous as any feudal lordlings in the thirteenth century, except public opinion, imperfectly expressed by the press."

Later he says: 'As for the introduction of the referendum and the initiative into the United States, there are, in reality, no insurmountable obstacles to bar the way.' And again: "Those who have no faith in the principles which underlie all genuine democracies, in the equality and brotherhood of man, and in his natural rights; who fear the people as an unreasoning beast which must be controlled; and therefore look to reform by means of artificial laws, rather than by those of nature—such men will naturally dread anything which savors of direct government, and will of course find the referendum and the initiative a stumbling block and a bugbear. But the increasing number of those who place their utmost confidence in the common sense of the people as a whole 'will welcome both as the most important contributions to the art of self government, which this century has yet seen.'" I have thus quoted at length on a subject that may not seem to be germane to our meeting, but which on a little reflection we can all see should *most* concern *us*. Assuredly all who desire their country's good will acknowledge that the writer speaks forth words of scientific truth and soberness.

The exposure of such existing evils,

here and now, brings us face to face with a biological principle to which we must all bow in attempted improvements or advancement, that of changed environmental relations and resulting modification therefrom. It can fairly be claimed that science has bettered and is bettering the environment of the workers, while it is uniting mankind in ever-widening bonds of unity and cooperation. Holyoake has well said: 'Cooperation is commercial peace, competition is commercial war.' The railroads that make possible scientific congresses, the steamships that link the scientists of continents in annual or triennial reunion, the telephones that almost annihilate phonic space, the food canning that makes life agreeable in every clime are a few of the many environmental products of the past century, that link man to man by chains of amity and peace, and that promote his international well-being.

Are the laws of science then, as we ordinarily understand these, to be our sole guide and rule in life? This inquiry causes me to recur to Huxley's picture of life already quoted. Are all the moves on the human chess board to be dictated only by thoughts of self-interest and self-preservation, or even by thoughts on behalf of our friends and offspring, as Huxley, in his later days, attempted to prove. Some of the 'moves' operated repeatedly in the world's past have given us as an environmental human outcome, products that we call 'strong lives,' 'strenuous lives,' 'unscrupulous lives,' 'useful lives,' 'instructive lives.' But the greatest type, and the one that we almost unconsciously worship is 'the beautiful life.'

Every organism from amœba to man lives by a process that we may call 'organic molecular equilibrium.' When the supplies of life energy and food integration exceed the dissipations and disintegration, growth and development proceed. When both are balanced maturity has been attained. When the converse to the first holds true, decay sets in. Applying this fundamental principle to our common human life, the highest human scientific aspiration might be expressed in the aphorism 'society an organism.' Such a condition society is far from having attained to. But like all organic bodies, if it is rightly to perform its functions, and to perpetuate its like, such it should become. At present, even in its highest expression, it consists of human molecules that often exhibit abundant energy, that undergo permutations and combinations, that show affinities and repulsions, but that lack some form of energy necessary to link them into an organic whole, to give them social equilibrium and stability. Society has been struggling through millennia to become an organism, has been searching for that energy and that source of energy that will give it life equilibrium. At times and in places the result seemed to have been achieved, only again to be impaired, or lost amid a chaos of discords, by the disrupting agency of one or of a few unscrupulous souls, who have acted like a disorganizing ferment on the organizing mass.

Though unfashionable with many to-day, and not least with the followers of science, the only motive form of human energy that has stood the test, and that is stronger to-day than ever before, is the power, the force of love, of compassion, of sympathy, as communicated by the greatest social lawgiver the world has seen. The early founders of Christianity were charged with it, and for three centuries they shook and finally subdued the Roman empire. We have it in our midst and it lives through all the upheavals consequent on human competition, on commercial war. In our hospitals, in our college settlements, in our

church and public beneficences, in our increased regard for human life, we feel the effects of this energy, though we see it not. The social settlements of Owen and others were truly preliminary nineteenth century scientific experiments to test the strength of the law of love, and the amount of this energy needed to vivify and unify the social organism. Like thousands of scientific experiments before and since they partially failed, but their failures and successes have been recorded, so that succeeding experimenters might carry the inquiry to a successful issue.

The fetish of unbridled commercial competition which has too long lorded over us, is in many ways inimical to our highest interests. It can be a helpful servant if kept in subjection, it becomes a harsh tyrant if worshipped as a god. It can not retain *supremacy* alongside the gospel of peace and love. If so, the latter suffers or becomes effaced, and mankind becomes the loser.

If back of all our failures and achievements, our hopes and our disappointments, some great and desirable human goal is not to be attained, then in spite of the genuine pleasure that comes from discovery of new knowledge, man may well turn from his labors exclaiming, 'Vanity of vanities, all is vanity.' But I thank God that beautiful lives have lived and still live, and that imperfect though I may be, energy—inspiration, if you care so to call it—can be got by drawing supplies of like energy as theirs from the great fountain head that has energized them. The science of life, and the religion of life *may* dwell apart, but who knows whether, when our profound ignorance has been dispelled, it may not appear that both are linked together, and are governed by similar great laws that we are asked by observation and experiment to verify and to accept.

Illimitable fields of research still remain for us to enter; the masses of our fellows are eager to learn what fruits we gather and bring back. We can only afford then to be optimists, and to exclaim with Mackay:

> Blessings on Science! When the earth seemed old,
> When Faith grew doting, and our reason cold,
> 'Twas she discovered that the world was young,
> And taught a language to its lisping tongue.

J. M. MACFARLANE.
UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC BOOKS.

Zoological Results based on Material from New Britain, New Guinea, Loyalty Islands and elsewhere collected during the Years 1895, 1896 and 1897. By ARTHUR WILLEY. Part VI. (August, 1902). Cambridge (Eng.) University Press. Pp. 691–830, pls. 75–83.

The sixth instalment of Willey's 'Zoological Results' is devoted entirely to an account of the natural history of the pearly nautilus and is by Dr. Willey himself. The account opens with a personal narrative in which he relates, in addition to the many observations bearing directly on the problem of securing the eggs of the pearly nautilus, numerous incidents and occurrences that he met with while sojourning among the inhabitants of the Eastern Archipelago. This is followed by a detailed account of the pearly nautilus itself.

Many interesting and important observations on the natural history of this animal are here recorded. The natural coloration is such that, though the animal is a conspicuous object when in the hand, it is quickly lost sight of when dropped into the sea, a condition which has led Willey to believe that its coloration is of a protective character. Sexual dimorphism in *Nautilus* has long been known and is easily recognized even in the dead shells. Willey has brought to light the remarkable fact that while in *Nautilus pompilius* the males outnumber the females (150 to 66), in *N. macromphalus* the reverse seems to be true (10 to 16). No important information was obtained as to the way in which the

nautilus forms new chambers in its shell. The breathing of the animal is in striking contrast to that of many other cephalopods. In *Octopus*, for instance, the inflation and emptying of the respiratory cavity involves the combined action of the muscular mantle and the funnel; in *Nautilus* the operation is carried out exclusively by the funnel, the mantle being a thin membrane applied to the inner surface of the shell. From the fact that animal bait of almost any kind may be used with success in capturing the nautilus, it is probable that this mollusc feeds naturally on almost any animal substance. Apparently it inhabits normally the bottom of the sea, for those taken near the surface are nearly always moribund. The wounds of injured specimens heal at the edges, but without regeneration. Variation was most noticeable in the disposition of certain unsymmetrical organs. Thus the main siphuncular artery may arise from either the left or the right division of the posterior pallial artery. In one instance a *situs inversus* of the reproductive organs was observed, in that the vas deferens was found on the left side instead of on the right and the pyriform gland was on the right, instead of the left. These and many other new observations on the structure and natural history of the nautilus fill the concluding part of the 'Zoological Results' and bear witness to the energy and patience of Dr. Willey as a field zoologist and explorer, even though in the end he was obliged to abandon his quest for the developing eggs of the pearly nautilus.

G. H. Parker.

Harvard University.

SCIENTIFIC JOURNALS.

The Journal of Comparative Neurology for June contains four leading articles, besides the usual book reviews: (1) 'An Enumeration of the Medullated Nerve Fibers in the Dorsal Roots of the Spinal Nerves of Man,' by Charles Ingbert. There is given a figure of a typical cross section of each dorsal spinal root, with a tabulation of the number of nerve fibers in each fascicle of each root. The total number of medullated nerve fibers in the dorsal roots of the left side of a large man is 653,627; the total area of the cross sections of these roots is 54.93 sq. mm.; there are on the average 11,900 medullated nerve fibers per sq. mm. of cross-section of these roots. This paper will be followed by a similar enumeration of the ventral roots. (2) 'On the Phylogeny and Morphological Position of the Terminal Buds of Fishes,' by C. Judson Herrick. On both physiological and morphological grounds these organs are to be classed with the taste buds of the mouth cavity and not with either tactile or lateral line organs. (3) 'On the Nature of the Pericellular Network of Nerve Cells,' by Shinkishi Hatai. Supports in general the views of Held that this network is composed of the terminal arborizations of axones of other neurones and concludes that the networks of Golgi and Bethe are of the same type. (4) 'The Neurokeratin in the Medullary Sheaths of the Peripheral Nerves of Mammals,' by Shinkishi Hatai. A new technique brings out the details of the structure of the neurokeratin framework more clearly than has hitherto been done. This substance is arranged in two layers, one beneath the primitive sheath and the other along the axis cylinder, which are connected by bands of neurokeratin which run obliquely from the outer to the inner layer in a funnel-shaped pattern. Neither the outer nor the inner layer is interrupted at the nodes of Ranvier.

The statement recently quoted in this journal regarding the establishment of the *Journal for Infectious Diseases* to be edited by Professors Ludvig Hektoen and E. O. Jordan is inaccurate. The journal is supported by contributions from Mr. and Mrs. Harold F. McCormick, but no specified sum has been given to endow the journal. It is to be published by the Memorial Institute for Infectious Diseases, not by the University of Chicago.

DISCUSSION AND CORRESPONDENCE.

THE GRAND GULF FORMATION.

To the Editor of Science: The communication of Dr. Dall on the Grand Gulf forma-

tion in your issue of July 17 seems to call for some comments on my part, since I am originally responsible both for the name and definition of that formation as such. The situation appears to me to be this, that while Smith and Aldrich bring what seems to be irrefragable proof that what I have described as the Grand Gulf formation is newer than any well-defined Oligocene, Dall lays stress upon the reported dipping of the Grand Gulf under Oligocene strata in Florida and Texas, and suggests that the 'Grand Gulf Sandstone' of Wailes is the original genuine Grand Gulf, with which certain clays and lignitiferous strata have subsequently been, perhaps wrongfully, associated.

Now as a matter of fact, Wailes used the term Grand Gulf sandstone merely as a lithological designation, not as the name of a formation; and while he correlates with it the sandstones of some other localities, he describes under the same general heading other light-colored sandstones, belonging, respectively, to the Burstone and to the Lafayette. On the other hand, he distinguishes by the name of 'Davion rock' the undoubted equivalent of the Grand Gulf at and below Fort Adams, Miss. According to usage, I might have adopted any other name for the formation as a whole, since Wailes failed adequately to characterize it. But as I found the exposure at Grand Gulf to be a really generalized and representative one, I thought it best to apply Wailes' lithological designation to the formation as a whole. It rests with me, therefore, to justify my correlation of the sandstone formation of the central portion of the Mississippi embayment with the clay formations from the Pascagoula to the Sabine, leaving to others the proof of identity beyond these limits.

In the absence of specificially identifiable fossils, it is not easy for the field geologist to satisfy the critics at home as to the correctness of his perception of that often indefinable something called *facies*, which is nevertheless oftentimes as cogent as specific identities of fossils, especially with the modern view of species. Even in the absence of the chalcedonization which characterizes the genuine (and rare) Grand Gulf 'petrified sandstone,' the sandstones of the Grand Gulf age can not easily be mistaken in the field for any of those occurring in other horizons in the southwest. From the Bayou Anacoco on the Sabine, via Bayou Funne Louis to Harrisonburg on the Washita, and from Grand Gulf to Raleigh, Miss., its facies, both lithologically and stratigraphically, is unmistakable, although the chalcedonized rock facies is mostly absent and everywhere, except at Grand Gulf, quite subordinate; mostly in thin ledges or lenticular masses. The sandstones, mostly rather soft, tend to cleave vertically rather than horizontally, and are markedly poor in mica.

The clays occurring interstratified with sandstone layers and ledges are sometimes, but not always, as characteristic as the sandstone itself, but much more so when occurring independently in large masses, as is especially the case on Pearl River and its tributaries. Doubtless the physical analysis of these massy clays, which range in tint from blue and green to reddish-gray, would be found to indicate the characteristics which render them so strikingly dissimilar to those of other formations of the southwest, whether older or later. One of their characteristics is the almost total absence of mica, which is so abundant in the earlier Tertiary as well as in the later Lafayette and is there conducive to the prevalent lamination; indicating apparently a derivation from different sources, not so far inland as to reach the micaceous metamorphics. The clays mostly contain a very large proportion of fine siliceous silt, so that while plastic they are not usually very adhesive. They are (especially in Louisiana) not infrequently consolidated into a soft siliceous claystone.

A highly interesting feature of the Grand Gulf clays is the local occurrence of calcareous concretions and veins, which I think may fairly be attributed to the presence, locally, of a rather copious fauna of shells, whose shape has been destroyed by maceration. In the calcareous clays underlying the 'Anacoco Prairie' in western Louisiana, many of the

concretions can almost as readily be construed into the forms of Natica, Nerita and Paludina as they are shown in the somewhat similar clays of the Port Hudson age, on the islands of Petite Anse and Côte Blanche. Here every degree of transition from the almost perfect shell into the roundish concretions can be traced; and I do not despair of a similar state of things being found within the largest calcareous deposit of the Grand Gulf area on the Anacoco when it shall be examined more at leisure than it was possible for me to do in 1869.

So far then as the central portion of the Grand Gulf formation in Mississippi and Louisiana is concerned, I see no escape from the conclusion that the sandstones and associated clays are rightly considered as being of one and the same geological age and formation, whether representing the upper Oligocene or later stages of the Tertiary. The hiatus between it and the Lafayette is emphasized alike by the extension of the latter two hundred and fifty miles farther inland, and by the totally changed lithological character of the materials, a change so great that it is hard to believe that the same Gulf waters should have produced both at any short interval of time. The conformity of the Lafayette to the Grand Gulf, referred to by Dr. Dall, is rather a delicate question when dealing with a formation of which stratification lines and dips are hardly predicable. The Lafayette overlies the Grand Gulf as it overlies every other formation in Mississippi and Louisiana, and it is there undoubtedly the next succeeding formation; but intervening beds may be found elsewhere. What was the nature of the event that caused the remarkable change in the whole nature and distribution of the two deposits must still, I think, be considered an unsolved problem.

E. W. Hilgard.

Berkeley, Cal.
July 22, 1903.

ANTARCTICA.

To the Editor of Science: My many American friends will be amused by the innuendo that I hate Americans which runs through Mr. Balch's notice (in your issue of July 10) of my review of his book in the *Geographical Journal* for May. It has always been a privilege of men of science to criticise each other's work as if they were members of one family, and I can conscientiously say for myself that I am without prejudice as to race, creed or nationality. Should I or any other European geographer differ from Mr. Balch or Fanning or Morrell, it is not because they are Americans and we are not, but because we think that in certain points they are mistaken.

The Atlantic is too wide for a comfortable controversy in a weekly journal to be conducted across it; and I do not think it would serve any useful end to reply to Mr. Balch's letter in detail. I fear that my review is too long for you to reprint, but nothing shorter would give a correct impression of my opinions on the points dealt with in Mr. Balch's very stimulating book. I should be glad if both were widely read.

Yours is a land of millionaires; the Antarctic is still scarcely touched by explorers, and all nations would rejoice to see a well-equipped American expedition sent out to help to solve the present problems which after all are those most nearly concerning us.

Hugh Robert Mill.

62 Camden Square, London, N. W.,
July 21, 1903.

SHORTER ARTICLES.

A NEW MOSQUITO.

Since mosquitoes have attracted so much attention of late through the part they play in the transmission of certain diseases, anything new that pertains to them or their life history may be of importance. In view of this fact, a brief description of a new species—which has been given the name of *Eucorethra underwoodi*—should be of interest. While this particular insect does not bite, and for this reason should not perhaps be regarded as a true mosquito, it has, however, been classed as one since it belongs to the family Culicidæ. The larvæ of this insect were found by me on January 27, 1903, in the Maine woods in the eastern

section of Penobscot County, and were discovered in a spring of water from which a crew of lumbermen were getting their water supply. A few days later, I found other larvæ of the same species in a similar spring about eight miles distant, though in this case, as the spring was not in use, it was covered with a coating of ice an inch thick. The temperature of the water at the bottom (it was about two feet deep) was 42° F.

At first sight this larva would be taken for an *Anopheles* of extraordinary size, as it is of the same general shape, and when the water was cleared of ice, it lay just beneath and parallel to the surface, breathing through a short respiratory siphon, as is characteristic of the larvæ of *Anopheles*. In this spring a barrel had been sunk and in the fifty gallons, or thereabouts, of water which it contained there were twenty-five larvæ. They were all of about the same size—12 to 14 mm. long—and almost black in color. All were secured and taken into camp for further investigation. Here they were kept for thirteen days at a temperature varying from 32° at night to 65° or 70° during parts of the day—an average temperature of about 45° F.

Close observation of the larvæ now showed that besides being much larger (12–14 mm. long instead of 5–7 mm.) they differed in many other particulars from the larvæ of *Anopheles*. In proportion to the rest of its body, its head is larger than the head of *Anopheles*. It does not turn its head upside down when feeding as does *Anopheles*. Its mandibles are strikingly large and powerful and are prominently toothed. It lacks the frontal tufts or brushes which are conspicuously present in *Anopheles*, and its antennæ, which extend directly forward parallel with the sides of the head, are much longer and more slender, and are tipped each with three hairs of equal size. The thorax is broadly elliptical and is much wider in comparison with its abdominal segments than is the thorax of *Anopheles*. The sides of the thorax and the abdominal segments bear fanshaped tufts of hairs, not plumosed as in *Anopheles*. The tufts on the last segments, both dorsal and ventral, are more profuse in *Eucorethra* than in *Anopheles*, especially the ventral tuft which in *Eucorethra* occupies nearly the whole segment. Only two anal papillæ are present, while *Anopheles* has four.

A few days before I returned to Boston, several larvæ died and three changed to pupæ. The pupa resembles that of *Culex* rather than of *Anopheles* and its respiratory siphons are of the same shape as in *Culex*. When stretched out at full length, the pupa measures ten mm.

On reaching home, the new wigglers, eighteen in number, were put into a quart jar which was placed near a window where it would receive the sunlight for two hours each morning. The temperature of the water now averaged about 70° F., and with this change the larvæ developed a new trait—they began to eat each other up. I witnessed the act on several occasions. The larva would grasp its adversary just forward of the respiratory siphon with its powerful mouth parts, and working the tail in first it would gradually swallow its victim, shaking it now and then as a terrier would shake a rat.

After losing a part of my stock in this way, those that remained were separated, and each individual was placed in a small bottle by itself. Eventually, I succeeded in rearing a number of males and females. The pupal stage of this insect varies from five days and nine hours to six days and ten hours. The adult resembles *Anopheles* in having maculated or spotted wings, but is much larger and measures eleven millimeters in length. Its mouth parts, however, are not adapted for biting. A full description of the imago is soon to be recorded by Mr. D. W. Coquillett of the National Museum by whom the name above mentioned was given.

Drawings were made of all the different stages and on May 26, 1903, they were sent to Dr. L. O. Howard, chief of the Division of Entomology, at Washington.

On July 24, word was received from Dr. Howard that a new genus had been made for the insect and that Mr. D. W. Coquillett had named it *Eucorethra underwoodi*. I was also

informed that the same insect had been sent in during July from British Columbia where it had been found by Dr. H. G. Dyer, who was collecting for the department.

During a visit to Maine in June, a large number of larvæ of *Eucorethra* were taken from the spring where the barrel had been sunk. It was noticeable that larvæ of other kinds of mosquitoes were absent, although the adults were very numerous in the immediate vicinity. During the past month many more larvæ have been sent me from the same source.

I found that they were very fond of the larvæ of the different species of *Culex* and that they ate them, apparently with great relish. On several occasions fourteen *Eucorethra* larvæ ate, during the night, sixty *Culex* larvæ out of the seventy that had been placed in the water with them. When eating the larvæ of mosquitoes smaller than themselves, the victim is caught, shaken violently a few times, and swallowed in a few seconds in very much the same way that a pickerel would catch and swallow a smaller fish.

As yet no experiments have been made to see if this new species will devour the larvæ of *Anopheles* as readily as they will those of *Culex*. Whether or not this species will thrive in the climate of southern New England is as yet uncertain, but experiments are now being carried on to determine this point.

Wm. Lyman Underwood.

Mass. Institute of Technology,
Boston.

THE ASCENDING OBELISK OF THE MONTAGNE PELÉE.

Not the least remarkable of the many extraordinary conditions that have been associated with the recent eruptions of the Martinique volcano is the extrusion of the giant tower of rock, a veritable obelisk, which today dominates the mountain, and which has given to it an added height of 800 to 900 feet. Pelée is no longer 4,200 or 4,428 feet in elevation, but upwards of 5,000 feet. On May 31 last, before it lost 180 feet of its summit, it reached exactly 5,200 feet. This tower of rock, the nature of which was first properly made known by Professor Lacroix, issues directly, and to all intents and purposes vertically, from the summit of the new cone of the volcano (of whatever precise nature this cone may be) which had been built up in the ancient crateral-basin (the Étang Sec) to a height of 1,600 feet or more, and virtually plugs it. Where it is implanted, it has a thickness of some 300 to 350 feet. From certain points of view the obelisk seems to maintain for most of its height (800+ feet) a fairly uniform thickness; from other points it shows a rapidly tapering surface, with a termination in a needle summit, a true *aiguille*. It is gently curved or arched toward the southwest, or in the direction of Saint Pierre, and on this face it is cavernous or openly slaggy, showing where successive and repeated explosions had carried away portions of the substance. On the opposite side, or toward the east-northeast, the surface appears solid, is smoothed and even polished in part, and shows longitudinal parallel grooves and striæ, very much like glacial markings. On this side it shows plainly the marks of hard attrition, the effect of rubbing upon the encasing rock—the mold, in fact, that determined a portion of the exit-channel.

The constitution of this extruded 'cork' is undeniably lava—a lava whose viscosity or rapid solidification did not permit it to flow over, but which under the giant stress of the volcano simply moved upward, solid from base to summit, and receiving accretions to its mass only from below. The most cursory examination of the relations existing would immediately point to this form of growth and development, but the carefully conducted angle-measurements and observations of contour made by the representatives at two stations of the French Scientific Commission leave no possibility of doubt in the matter, and they further furnish us with data touching the rate of growth. Thus, in eight days preceding June 7 this growth was, as we are informed by M. Giraud, ten meters; and in the four days preceding June 15 (a period within the time of my recent visit to the volcano) it measured six meters. The consideration of the depth to which this giant

monument descends solid into the volcano would be interesting were there any way of reaching the problem, but for the present there would seem to be none such.

On June 13 last, in company with M. Guinoiseau—one of the observers of the French Commission—I made the ascent of Pelée, and from the immediate crater-rim took a series of photographs of Pelée's singular process, probably the most impressive piece of nature that I had ever seen. The volcano, by comparison with what it had been before, had 'slumbered down to peace,' but yet it was too active to permit us to descend into the crateral-hollow, 300 to 350 feet in depth, that still surrounded the new cone. Steam- and sulphur-puffs were issuing everywhere, and avalanches of rock were repeatedly being disengaged from the obelisk. Pelée was still 'ugly,' and the night before, the southwest base of its crown or plug was glowing with fire—with the liquid lava that was rising in rift-passages. Two days later I noted a feeble line of steam issuing from the absolute apex of the summit, suggesting a continuous passage or channel extending from base to summit. On March 26 a discharge of incandescent balls was observed also to take place from the same position.

Geologists will naturally make a comparison between the Pelée structure and that which was observed to rise in Georgios, in Santorin, in 1867; but the dome of the latter is probably nearer to the cone of Pelée, and suggests little of the obelisk and of its method of formation. And, perhaps, not much more can be said in any comparison that might be made with the 'pyramidated' summits of some of the equatorial volcanoes of South America, whose contours have been given to us by Professor Stübel.

ANGELO HEILPRIN.
GEOGRAPHICAL SOCIETY OF PHILADELPHIA,
July 18, 1903.

CURRENT NOTES ON METEOROLOGY.

HEALTH ON THE ISTHMUS OF PANAMA.

IN a recent number of the *Monthly Weather Review* (Vol. XXXI., No. 3) General Henry L. Abbot, who has for some years made a special study of the climatological conditions of the Isthmus of Panama, publishes a summary of the climate and health of that district which will prove of general interest at the present time. General Abbot has previously written several discussions of this subject, some notes on which have appeared in these columns. Probably what General Abbot has to say about health on the Isthmus will have the greatest interest just now. Regarding the earlier health statistics, during the construction of the Panama Railroad, it is stated that they 'are well known to have been appalling.' But, as is pointed out, "at that date it was not understood that natives of the temperate regions can not safely perform arduous manual labor under exposure to a tropical sun, and that dependence for such work must be placed upon the negroes of the West Indies. White men can supervise, but must not attempt more." The table of 'Official Health Statistics' of the Panama Canal, published in the article, may be briefly summarized as follows:

Old Company, 1881–1888, percentage of mortality from disease (European and tropical), 5.97.

Receiver, 1889–1894, percentage of mortality from disease (European and tropical), 2.88.

New Company, 1895–1901, percentage of mortality from disease (European and tropical), 2.61.

The marked improvement shown in recent years is attributed by Dr. Lavoisade, the medical director of the company hospital near Panama, to the better accommodations of the laborers, better drainage, and especially to the fact that the excavations have reached a level below the poisonous emanations of decaying organic matter. For the years 1898–1901 the percentage of mortality from disease was 2.35, which is said not to exceed that on large works in any country. The men herein concerned had, however, been long on the Isthmus. As to yellow fever, the disease most to be feared by unacclimated persons of the white race, during two recent epidemics (in 1899 and 1900), only two cases appeared among the personnel of the company. Dr. Lavoisade believes that yellow fever 'is in no wise necessarily endemic' on the Isthmus.

CLIMATE AND RAILROADING.

As the subject of a thesis in the course in General Climatology in Harvard University, Mr. Robert M. Brown took 'Climatic Factors in Railroad Construction and Operation,' and some of the results of the study are embodied in an article under the above title in a recent number of the *Journal of Geography* (Vol. II., pp. 178–190). For purposes of classification the different districts of the world are arbitrarily grouped as regions of heavy precipitation; of moderate precipitation; of light precipitation; of high altitudes and of severe winters. In each of these regions there are climatic difficulties which must be solved by the engineers and operating officials during construction, and after the road has been built. Where the rainfall is heavy there is decay of ties, sleepers and bridges; there are floods and landslides. In regions of light rainfall there is great danger of fire; water must be piped for long distances or else carried in tanks; labor is often difficult on account of the heat; sand is blown by the wind, accumulating on the rails, blinding the drivers, and injuring the machinery. When the altitude is high, mountain sickness, snow blockades and snow-slides must be overcome. In regions of severe winters ice breakers may be needed to keep open lakes and rivers, or temporary rails may be laid on the ice; snow and ice hinder construction and operation, and the number of working days may be seriously reduced. Mr. Brown mentions specific instances to illustrate these various climatic controls, and the article is a distinct contribution, albeit an incomplete study in itself, on the human side of climatology. It so happens that three railroads now building, or projected, furnish numerous excellent examples of the kind of control considered in Mr. Brown's paper. These are the proposed Trans-Canada and Trans-Australian lines, and the Uganda Railway. The former is interesting because of the high latitudes which it is to traverse; the second, because its route lies across the central arid portion of Australia, and the third by reason of its being in tropical Africa.

R. DeC. Ward.

Harvard University.

RADIUM AND HELIUM.

A paper bearing in a remarkable way on the connection between these two elements, which is now exciting so much interest, has been received for publication by the Royal Society from Sir W. and Lady Huggins. Prompted, in fact, by theoretical ideas, they attacked the problem of the spectroscopic analysis of the light emitted directly by a radium salt at ordinary temperatures. Preliminary visual observation seemed to show traces of bright lines in a continuous spectrum. Preparations were accordingly made for photographic record by means of a small quartz spectroscope constructed some years ago for use on very faint celestial objects. After several trials, a spectrum, consisting of eight definite bright lines in the ultra-violet, entirely different from the spark spectrum of radium, and some faint lines together with a very faint continuous spectrum, was obtained by 72 hours' exposure to the glow. The lines were of some breadth, on account of the wide slit that had to be employed in order to admit sufficient light; but it was found possible to measure their wave lengths within an error of two in the fourth figure. On a comparison of this spectrum, so different in type from an ordinary phosphorescent spectrum, with the recorded measurements for helium, it appeared at once that four, and perhaps five, of the eight lines agreed with lines of helium within the uncertainty of the measurements. Another line, that of the highest refrangibility, agrees with a line in the spark spectrum of radium itself, which, however, has not been recorded by other observers; the two other lines, the lowest, have not yet been traced.

It will be remembered that last year Professor Rutherford produced striking evidence for the view that, in the very slow break-up of radium that is concomitant with its radio-activity, the inert gas helium is one of the products formed. Recently Sir W. Ramsay and Mr. F. Soddy have succeeded in detecting helium by the spectroscope in the gases extracted from a radium salt. If, as the present observations indicate, the radium salt shines spontaneously in the dark largely by light belonging to the different element helium, an-

other important step is gained in elucidating the nature of the instability of such chemical elements of high atomic weight and the radioactivity associated with it.—The London *Times*.

The possibilities of such mysterious forces as those possessed by radium present an attractive field of speculation for the physician. May not the radiant energy emitted by radium possess pathogenic as well as curative, destructive as well as stimulating, powers on cells and cellular processes? Perchance, it may be forces of this kind that upset physiologic laws of cellular activity, and lead to abnormal proliferations of various kinds? But questions of this kind are not yet ripe for discussion. Actual experimental studies must furnish the necessary basis of facts from which it may be permitted to draw further deductions. Danysz found that radium destroys the skin of guinea-pigs and rabbits, but subcutaneous and muscular tissue do not seem so sensitive as skin. The nervous tissue is also sensitive to its action. A sealed glass tube with salts of radium placed against the skin over the spine is followed by death in young animals. In older animals the osseous tissue seems to protect the spinal cord against the radiations. The effects of rays of radium on bacteria have not been studied extensively as yet, but both Danysz and Bohn show that various larvæ and embryos are profoundly modified in their growth, many being killed when subjected to the radiations; others developing into monstrosities because of unequal stimulation. Bohn further finds that radium exercises an especially intense action on tissues or cells in proliferation; non-fertilized eggs may undergo more or less parthenogenetic development and give rise to atypical formations. It has been found, too, that in animals whose skin was burned by the rays, the hair, in some cases, appeared to be forced into rapid growth. It seems that various effects are obtainable, depending on the tissue or cell exposed, as well as on the quantity and quality of the rays. Further experiments, no doubt, will yield even more interesting and conclusive results. We have commented on the announcement that in Vienna cancer has been cured by means of radium. In this particular direction much work will surely be done, and we may expect interesting developments.—*Journal of the American Medical Association.*

SUMMER WORK OF THE GEOLOGICAL SURVEY.

THE preliminary arrangements for the present season are as follows:

Adams, Dr. George I., assistant geologist, will complete study of northern Arkansas lead and zinc district, with some revision of Yellville and Fayetteville quadrangles. On its completion, associated with Dr. Erasmus Haworth, will make an areal and economic survey of Iola thirty-minute quadrangle, Kansas. Later will make reconnaissance of stratigraphy of Coal Measures and Permian in northern Texas.

Alden, Wm. C., assistant geologist, will continue work on Pleistocene geology of quadrangles in southeastern Wisconsin.

Arnold, Dr. Ralph, geologic aid, will assist Dr. Wm. H. Dall in completion of monograph on southeastern and Florida Tertiaries, and Dr. J. C. Branner on the paleontology of the Santa Cruz quadrangle, California.

Ashley, Dr. George H., assistant geologist, will complete, under supervision of M. R. Campbell, study of Cumberland Gap coal field, in cooperation with state of Kentucky.

Atwood, W. W., assistant geologist, will assist Professor R. D. Salisbury in glacial work west of one-hundredth meridian.

Bain, Dr. H. Foster, geologist, will begin systematic study of lead and zinc deposits of Mississippi valley. Will make detailed surveys in southern Illinois and in Galena district in northwestern Illinois; and will visit points in Wisconsin and Missouri for cooperation with state surveys.

Bascom, Dr. Florence, assistant geologist, will complete necessary field work and prepare for publication the Philadelphia Special folio, embracing four fifteen-minute quadrangles.

Bayley, Dr. W. S., assistant geologist, will survey crystalline rocks of Raritan quadrangle, New Jersey.

Boutwell, John M., assistant geologist, will complete investigation of mining geology of Park City district, Utah, and make a reconnaisance of Coalville quadrangle.

Branner, Professor J. C., geologist, will continue areal work in Santa Cruz quadrangle, California, and prepare the folio for publication.

Brooks, Alfred H., geologist in charge of geologic work in Alaska, will continue supervision of geologic work in Alaska. Will visit the Spencer party at Juneau, and later spend six weeks in company with L. M. Prindle in visiting region of lately discovered placer gold fields in Tanana Valley. Latter part of season he will spend in Seward Peninsula visiting the Collier and Moffit parties.

Butts, Charles, assistant geologist, under supervision of M. R. Campbell, will continue areal and economic surveys on quadrangles in western Pennsylvania, in cooperation with state.

Calhoun, F. H. H., assistant geologist, will assist Professor R. D. Salisbury in glacial work west of one-hundredth meridian.

Calkins, F. C., assistant geologist, will assist Dr. F. L. Ransome in study of areal and economic geology of Cœur d'Alene mining district, Idaho. Later in the year will assist George H. Eldridge in areal work in southern California.

Campbell, M. R., geologist, will have immediate supervision of areal and economic work in Appalachian coal field.

Chamberlin, Professor T. C., chief of section, will continue supervision of investigations of Pleistocene geology of United States.

Clapp, Frederick G., geologic aid, under supervision of M. R. Campbell, will continue areal and economic surveys on quadrangles in western Pennsylvania, in cooperation with state.

Collier, Arthur J., assistant geologist, will make careful investigation of gold placers of Seward Peninsula, Alaska, with view to supplementing hasty reconnaissance work of previous years. Will also undertake some areal mapping and stratigraphic studies in this region.

Crane, Professor W. R., field assistant, will assist Dr. Geo. I. Adams in the measurement of gas pressures in connection with the survey of Iola thirty-minute quadrangle, Kansas.

Cross, Dr. Whitman, chief of section, will continue investigation of areal geology of San Juan district, Colorado, and have general supervision of investigations in petrology throughout the United States.

Dale, Professor T. Nelson, geologist, will continue investigation of areal and economic problems in western Vermont, and survey the Brandon quadrangle for folio publication.

Dall, Dr. Wm. H., geologist and paleontologist, will be occupied during greater part of year in completion of monograph on southeastern and Florida Tertiaries. On completion of that work he will take up study of invertebrate Tertiary paleontology of Pacific coast.

Diller, J. S., geologist, will complete areal and economic survey of Redding quadrangle, California, and make general reconnaissance of geology of Klamath Mountains.

Dominian, Leon, field assistant, will assist J. E. Spurr in completion of economic investigation of Tonopah mining district, Nevada, and in economic geology work in Silver Peak quadrangle, Nevada.

Eckel, Edwin C., assistant geologist, will make detailed investigation of cement industry of United States.

Eldridge, George H., geologist, will spend first half of year in completion of reports on Florida phosphates and California oil fields. Later in season will take up areal work in southern California.

Emerson, Professor B. K., assistant geologist, will continue work on areal geology of central Massachusetts.

Emmons, S. F., chief of section, will be occupied throughout the year with supervision of investigations of metalliferous ores and completion of report on geology of Leadville mining district.

Gale, Hoyt S., geologic aid, will assist Ar-

thur Keith in completion of survey of Cowee and Pisgah quadrangles, North Carolina, and in a reconnaissance of adjacent quadrangles.

Gilbert, G. K., geologist, will carry on investigations in glaciology in the high Sierras of California.

Girty, Dr. George H., assistant geologist, will be occupied the greater portion of the season with office work on collections now in hand. Will spend a part of the season in continuation of field work on the Waverly problem in Ohio.

Griswold, W. T., topographer, under supervision of M. R. Campbell, will study structure and stratigraphy of Steubenville and Wellsville quadrangles, Ohio-West Virginia, and of St. Clair quadrangle, Ohio, with special reference to location of oil and gas pools.

Hague, Arnold, geologist, will be occupied with the completion of his monograph on the geology of the Yellowstone National Park.

Hatcher, Dr. J. B., field assistant, will assist Dr. T. W. Stanton in study of non-marine Mesozoic formations of northern Montana.

Haworth, Professor Erasmus, assistant geologist, will be associated with Dr. George I. Adams in areal and economic survey of Iola thirty-minute quadrangle, Kansas.

Hayes, Dr. C. W., geologist in charge of geology, will continue administration of Division of Geology and Paleontology, and will have supervision of investigations in non-metalliferous economic minerals.

Hess, Frank L., field assistant, will assist Arthur J. Collier in study of gold placers of Seward Peninsula, Alaska. Also in areal mapping and stratigraphic studies in the same region under supervision of Alfred H. Brooks.

Hollick, Dr. Arthur, assistant geologist, will visit a number of localities on the Yukon River, Alaska, for the purpose of making detailed stratigraphic studies and paleontologic collections, under supervision of A. H. Brooks.

Howe, Ernest, assistant geologist, will assist Dr. Whitman Cross in investigation of areal geology of San Juan district, Colorado.

Jaggar, Dr. T. A., assistant geologist, will be occupied with the completion of reports on the Sturgis-Spearfish folio, North Dakota, and the Bradshaw Mountain folio, Arizona.

Johannsen, Albert, field assistant, will assist Dr. Whitman Cross in investigation of areal geology of San Juan district, Colorado.

Keith, Arthur, geologist, will continue areal and economic work in the southern Appalachian Mountains. His work will consist in completion of surveys of the Cowee and Pisgah quadrangles, North Carolina, and a reconnaissance of adjacent quadrangles.

Kindle, E. M., assistant geologist, will assist Professor H. S. Williams in areal survey of Ithaca thirty-minute quadrangle, New York.

Knowlton, Dr. F. H., paleontologist, will be occupied throughout the year in paleo-botanical work upon collections on hand.

La Forge, Lawrence, assistant geologist, will assist Dr. W. S. Bayley in survey of crystalline rocks of Raritan quadrangle, New Jersey.

Leith, Dr. C. K., assistant geologist, will assist Dr. C. R. Van Hise in preparation of final report on geology of Lake Superior region.

Leverett, Frank, geologist, will continue work on the preparation of a monograph on the Pleistocene formations of the Lower Peninsula of Michigan and adjacent portions of Indiana. Will also survey Ann Arbor thirty-minute quadrangle for folio publication.

Lindgren, Dr. Waldemar, geologist, will make a resurvey of the Cripple Creek district, Colorado, in cooperation with the state, associated with Dr. Ransome.

Martin, Dr. George C., special assistant, will make an economic reconnaissance of Controller Bay coal and oil fields and of a part of coal and oil fields of Cook Inlet region, under supervision of A. H. Brooks. Will prepare Accident-Grantsville, Maryland, geologic folio for publication.

Moffit, F. H., assistant geologist, will make reconnaissance of northeastern part of Seward Peninsula, giving special attention to problems connected with occurrence of placer gold. Will be with topographic party in charge of D. C. Witherspoon, topographer, under supervision of A. H. Brooks.

Paige, Sidney, field assistant, will assist Dr. Arthur Hollick, who will visit a number of localities on the Yukon for the purpose of

making detailed stratigraphic studies and paleontological collections.

Peterson, William, field assistant, will assist Professor R. D. Salisbury in glacial work west of one-hundredth meridian.

Prindle, L. M., special assistant, will make reconnaissance surveys of Fortymile, Birch Creek and Lower Tanana placer gold fields.

Purdue, Professor A. H., field assistant, will assist Dr. George I. Adams in study of north Arkansas lead and zinc district.

Ransome, Dr. F. L., geologist, associated with Dr. Lindgren, will make a resurvey of the Cripple Creek district, Colorado, in cooperation with the state, and will study areal and economic geology of Cœur d'Alene mining district, Idaho.

Russell, Professor I. C., geologist, will make a geologic reconnaissance of western Idaho and central Oregon, in cooperation with Division of Hydrography.

Salisbury, Professor R. D., geologist, will have immediate supervision over glacial work west of one-hundredth meridian.

Schrader, F. C., geologist, will be occupied in completing reports on geology and mineral resources of northern Alaska, and on the geology and mineral resources of Upper Copper River region.

Smith, Dr. George Otis, geologist, will carry on areal and economic work in Maine, in cooperation with State Geological Survey.

Smith, W. N., field assistant, will assist Dr. C. R. Van Hise in preparation of final report on geology of Lake Superior region.

Smith, Dr. W. S. Tangier, assistant geologist, will complete reports on lead and zinc deposits of Joplin, Missouri, and western Kentucky districts, and complete areal field work on pre-Cambrian areas in the Sundance quadrangle, South Dakota.

Spencer, Dr. Arthur C., geologist, will investigate areal and economic geology of Juneau mining district. Later will make reconnaisance of economic geology of Berners Bay and some of the other mining districts of southeastern Alaska.

Spurr, J. E., geologist, will complete economic investigation of Tonopah mining district, Nevada, and will revise economic geology of Silver Peak quadrangle, Nevada.

Stanton, Dr. T. W., chief of section, will make a study of non-marine Mesozoic formations of northern Montana, and later in season will visit various Lower Triassic localities in southeastern Idaho and northern Utah, and Cretaceous outcrops in southern Wyoming; and will have general supervision of investigations in paleontology throughout the United States.

Stone, Ralph W., assistant geologist, under supervision of M. R. Campbell, will continue areal and economic surveys of quadrangles in western Pennsylvania, in cooperation with state.

Stose, George W., editor geologic maps, geologist, will be occupied chiefly in editing geologic maps, but will spend a short field season in completion of areal work on Chambersburg quadrangle, Pennsylvania.

Taff, J. A., geologist, will be occupied with the preparation of reports on Indian Territory coal fields.

Taylor, Frank B., field assistant, will continue preparation of his contribution to Leverett monograph, and will complete his work on Pleistocene geology of Taconic quadrangle.

Ulrich, E. O., assistant geologist, will study the paleontology and stratigraphy of the Ordovician and Silurian of the upper Mississippi Valley, and in connection with various geologic parties elsewhere.

Van Hise, Dr. C. R., chief of section, will continue supervision of investigations in pre-Cambrian and metamorphic geology of United States, and will prepare final report on geology of Lake Superior region.

Vaughan, Dr. T. W., geologist, will continue preparation of monograph on fossil corals of United States.

Ward, Professor Lester F., paleontologist, will continue preparation of series of papers on Mesozoic floras of United States, completing the second paper on the older Potomac, the Shasta, the Kootanie and Trinity, and taking up the Middle Cretaceous.

Weed, W. H., geologist, will be occupied with completion of report on economic geology

of Butte mining district, Montana, and will continue field work in investigation of copper deposits in Appalachian region.

White, David, geologist, will continue investigation on paleobotany of the Pottsville and higher Coal Measures in the Appalachian field and will make reconnaissance examination of paleobotany of northern Texas coal field.

Williams, Professor H. S., geologist and paleontologist, will make areal survey of Ithaca thirty-minute quadrangle, New York, and continue studies on Devonian paleontology and stratigraphy.

Willis, Bailey, chief of section, has been granted leave of absence for a year, to carry on stratigraphic investigations in China under the Carnegie Institution.

Wolff, Professor John E., assistant geologist, will continue areal surveys in southern Vermont and New Hampshire.

Woolsey, Lester H., assistant geologist, will assist John M. Boutwell in completion of investigation of mining geology of Park City district, Utah, and in reconnaissance of Coalville quadrangle.

Wright, Charles W., field assistant, will assist Dr. Arthur C. Spencer in investigation of areal and economic geology of Juneau mining district, and in reconnaissance of economic geology of Berners Bay and other mining districts of southeastern Alaska.

SCIENTIFIC NOTES AND NEWS.

SIR W. RAMSAY has been elected president of the Society of Chemical Industry. The society has decided to meet next year in New York City.

IN order to devote his entire time to the work of the newly organized Department of Anthropology and Ethnology in the Louisiana Purchase Exposition, Dr. W J McGee resigned his position in the Bureau of American Ethnology on July 31, and assumed duty as chief of the new department on August 1. The exhibits will include living representative groups of various primitive peoples, an Indian school in regular operation, and sections of archeology, history, etc.

IT is proposed to celebrate the seventieth birthday of Professor August Weismann, which will occur on January 17, 1904. The committee has decided to have prepared for that time a portrait bust of Professor Weismann which shall be deposited at the Zoological Institute of the University of Freiburg with appropriate festivities. It invites cooperation in this undertaking, not only from those who owe scientific stimulus to Professor Weismann and have been guided by him into zoological activity, but also from all colleagues who desire to join in honoring Professor Weismann for his work. Contributions may be sent to the Deutsche Bank, Leipzig, for the account of Professor Zur Strassen, who is treasurer. The alphabetical list of all contributors without statement of amount will be printed, and will accompany the bust. The American members of the committee of fifteen are Professor H. H. Wilder, of Smith College, and Professor Henry B. Ward, of the University of Nebraska.

THE Worshipful Company of Drapers have contributed £1,000 to assist Professor Karl Pearson in his statistical researches at University College, London, and in the higher work of his department.

MR. J. HUTCHINSON, F.R.S., who has recently returned from the study of leprosy in India, was given a complimentary dinner on July 23 by the members of the medical profession to celebrate his seventy-fifth birthday.

MR. CHARLES SCHUCHERT will represent the U. S. National Museum at the Vienna International Congress of Geologists. He is at present studying European, Silurian and Devonian rocks.

MR. FORD A. CARPENTER, U. S. Weather Bureau, San Diego, Cal., has sailed for San Quetin, Mexico, where he will spend a month in meteorological and other investigations on the San Piedra Martir, a 12,000 foot plateau in the Baja California peninsula.

The American Geologist states that Dr. C. R. Eastman, of Harvard University, who has been spending his sabbatical year abroad in special paleontological research, has returned

to Europe in company with Dr. Holland, director of the Carnegie Museum, to take up the study of the fossil fishes in the famous Bayet collection, recently acquired by the museum.

M. Baccelli has been elected a corresponding member of the Paris Academy of Sciences in the section of medicine, in the room of the late M. Olier.

At the recent meeting of the Royal Institute of Public Health its Harben medals of 1901 and 1902 were presented to Sir Charles Cameron and Professor W. R. Smith.

The hundredth anniversary of the birth of Ericsson was celebrated on July 31 by the unveiling of a new statue in his honor erected in the Battery, New York City. Addresses were made by Mayor Low and Col. William C. Church, the author of the life of Ericsson. The statue was remodeled by the sculptor, Mr. Jonathan S. Hartley, from his former work, erected in the Battery in 1893.

Subscriptions to the amount of about $450 have been contributed in Great Britain toward the marble statute of von Pettenkofer, which is to be erected at Munich.

General Brialmont, the Belgian military engineer, has died at the age of eighty-two years.

The French Association for the Advancement of Science will begin its thirty-second meeting at Angers on August 4, under the presidency of M. Emile Levasseur, professor of geography and agriculture at Paris.

An International Sanitary Conference is to be held at Paris, beginning on October 10.

The British government has appointed Captain Harry Mackay, a Dundee whaling master, to the command of the *Discovery* relief expedition. Captain Mackay was master of the relief ship *Terra Nova* when employed as a Dundee whaler, and master of Mr. Barclay Walker's Arctic yacht *Eskimo*, now the steamship *America*, in the Zeigler-Polar expedition.

The secretary of the committee of the Bessemer Memorial Fund announces that for the purposes of advanced metallurgical training and specialized research work it is proposed that London shall be regarded as the center for the metallurgy of copper, silver, gold, etc.; Sheffield as the center for steel; and Birmingham as the center for cast and wrought iron and alloys. This decision will not, however, prejudice the claims of other metallurgical centers for participation in the fund. It is also intended that the post-graduate scholarships shall, in part, be international.

A Laffan telegram from Berlin states that during the months of May and June Professors Wolf and Dugan, of the Königstuhl Observatory, near Heidelberg, have by means of long photographic exposure discovered eight little planets, provisionally indicated by 1903, L Q to L X. They vary between the 11th and 14th magnitude.

UNIVERSITY AND EDUCATIONAL NEWS.

Mrs. Hettie F. Ballantyne, of Pittsburgh, has given $20,000 to Allegheny College for the endowment of scholarships.

Syracuse University is to receive one third of the residue of the estate of the late Mrs. Caroline S. Reid.

Mr. J. Martin White, of Dundee, has given to the University of London a sum of £1,000 for the provision of courses of lectures in sociology, including anthropology, social psychology, social philosophy and ethics.

At the University of London Mrs. Bryant, D.Sc., Sir Henry Howse, D.Sc., and Dr. A. D. Waller, F.R.S., have been elected vice-chairmen of the board to promote the extension of university teaching, the committee of the medical members of the senate, and the scientific apparatus committee respectively.

Dr. Karl Wilhelm Genthe, for the last two years instructor in natural history in Trinity College, has been promoted to an assistant professorship in that institution.

Dr. C. B. Waller, assistant professor of mathematics at Clemson College, S. C., has been elected professor of chemistry and biology at Wofford College, Spartanburg, S. C.